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PATENT ABSTRACTS OF JAPAN

(11)Publication number : **2000-331959**
(43)Date of publication of application : **30.11.2000**

(51)Int.CI. H01L 21/288
H01L 21/3205

(21)Application number : **11-135485**
(22)Date of filing : **17.05.1999**

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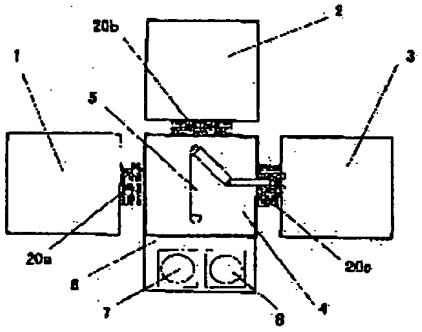
(54) METHOD AND DEVICE FOR TREATING SUBSTRATE

(57)Abstract:
PROBLEM TO BE SOLVED: To reduce variation in history of treated substrates (wafers).
SOLUTION: In a method for treating substrates, wafers can be transferred between a plating process, a cleaning process, and an annealing process by means of a transfer machine 5 in a fully automated state, and the wafers can be stably and continuously subjected to plating, cleaning, and annealing treatments, because the plating chamber 1 of plating equipment, a cleaning chamber 2 of cleaning equipment, and an annealing chamber 3 of annealing equipment are arranged around a collecting chamber 4 in which the transfer machine 5 is set up. Consequently, the transfer time of the wafers can be shortened, and the waiting time in equipment is reduced. Therefore, the time required for the series of processes of plating, cleaning, and annealing processes is stabilized, and the variation in the history of the wafers can be reduced.



LEGAL STATUS

[Date of request for examination]

[Date of sending the examiner's decision of rejection]

[Kind of final disposal of application other than the examiner's decision of rejection or application converted registration]

[Date of final disposal for application]

[Patent number]

[Date of registration]

[Number of appeal against examiner's decision of rejection]

[Date of requesting appeal against examiner's decision of rejection]

[Date of extinction of right]

DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[The technical field to which invention belongs] this invention relates to the substrate art and equipment which perform plating processing of the metal wiring formation process of the manufacturing processes of a semiconductor device or electronic parts, washing processing, and annealing processing.

[0002]

[Description of the Prior Art] The metal wiring formation process in the manufacturing process of a semiconductor device is explained referring to drawing 12 first. Drawing 12 is the cross section of an example of a semiconductor device. 27 The wafer of silicon, The insulator layer of the silicon oxide by which 28 was formed in the wafer 27, the polysilicon contest wiring which consists of contest polysilicon with which 29 contains conductive ion, The metal wiring with which 30, 32, and 34 consist of metals, such as copper, as for the insulator layer of a glass component, and 31 and 33, the connection which formed 35a, 35b, and 35c in parts for an element terminal area, such as the base of a transistor, an emitter, and a collector, and formed 36a, 36b, and 36c in the insulator layer 30 -- the connection which formed a hole and 37 in the insulator layer 32 -- it is a hole

[0003] Wiring for impressing voltage to it at parts for the element terminal area 35a, 35b, and 35c, after forming elements, such as an insulator layer 28 and a transistor, in a wafer 27 (for example, refer to "newest LSI process technical" Maeda [Kazuo] work, the Kogyo Chosakai Publishing Co., Ltd. issue, 1983/07/20 publication, and 21 - 80 pages) is performed. First, the polysilicon contest wiring 29 is formed in the portion connected with parts for the element terminal area 35a, 35b, and 35c. This is because wiring of a direct metal cannot be formed in a silicon front face. the it top after forming the polysilicon contest wiring 29 -- an insulator layer 30 -- forming -- the connection for the wiring for leading about -- Holes 36a, 36b, and 36c are formed the next -- connection -- the metal wiring 31 embedded at Holes 36a, 36b, and 36c is formed by plating processing Then, although an insulator layer 32 must be formed, metal contamination is carried out and the front face flooded in plating liquid by plating processing is unsuitable to formation of an insulator layer 32. Then, washing processing is performed. after washing -- an insulator layer 32 -- forming -- connection -- a hole 37 is formed the next -- connection -- the metal wiring 33 embedded at a hole 37 is formed by plating processing

[0004] ****** metal particles have only joined very much, and the metal wiring 31 and 33 formed by plating processing changes and has resistance and stable hardness in neither aging nor a temperature change. Then, annealing processing is performed, in order to grow up greatly heating and carrying out the fused junction of the metal particles etc. and to form a precise film.

[0005] At the conventional metal wiring formation process, the plating processor, the annealing processor, and the washing processor have been arranged, the cassette which inserted two or more substrates (wafer) was conveyed to each equipment, and process processing with each equipment was performed. Drawing 9 is a block diagram of equipment which performs plating processing, conventional annealing processing, and conventional washing processing. As shown in drawing 9 , the plating processor 22, the washing processor 23, and the annealing processor 24 are arranged in one train, an unfinished product places between each processor or before and after it, and Bases

25a, 25b, 25c, and 25d are arranged. The unfinished product of each processor placed the cassette before each process processing, and the unfinished product was put on Bases 25a, 25b, 25c, and 25d in accordance with the throughput of the processor. That is, the unfinished product in front of the process of the washing processor 23 placed, and when pre- processing was like [galvanizer], while the plating processor 22 had stopped at maintenance or failure, the unfinished product for washing processor 23 was put on base 25b so that operation of a washing process might not stop simultaneously. It can say about the annealing processor 24 similarly. This production system had that a burst size was influenced [little] by the equipment operating ratio, and was producible stable.

[0006]

[Problem(s) to be Solved by the Invention] However, the demand to equalization of the history of wafers, such as lead time shortening and highly-precise-izing of the process control accompanying detailed-izing of a semiconductor device, for example, atmosphere control etc., or improvement in quality is becoming severe.

[0007] Drawing 10 is drawing showing the equipment processing time over the predetermined number of sheets of a wafer. In drawing 10 , the equipment processing time of a vertical axis is the total time after the 1st wafer reaches equipment until processing of predetermined number of sheets is completed completely, and includes the latency time. Although the wafer receipt number of sheets into a cassette is a 25-sheet standard, when carrying out lot management, it may use 50 sheets (two cassettes) as one lot. If the number of sheets per one lot is reduced temporarily, an average access time until predetermined number of sheets gathers simultaneously is short, and it turns out by the bird clapper that the equipment processing time per one lot is decreasing. That is, if the number of sheets per one lot is increased, dispersion only in the part of the difference of the height of a bar graph will be between the wafers of the last of the lot with the 1st sheet, and a wafer history will be made to differ in one sheet, although it is always fixed.

[0008] Moreover, drawing 11 is drawing having shown elapsed time and its thickness about the oxide film adhering to the front face, when the front face of a wafer is being worn with the metal.

[0009] In the case of surface states which are in a state with an unstable wafer front face and which are easy to oxidize, such as a case, for example, copper etc., it can say that completing process processing, with the membraneous quality of a predetermined state maintained can keep wafer quality uniform in the good state by performing process processing for a short time. Furthermore, adhesion of the unnecessary film said to the wafer front face as the oxide film can also be suppressed by process-processing and conveying in an inactive atmosphere, to the minimum.

[0010] Though process processing was carried out in an inactive atmosphere or the wafer was conveyed, since adhesion of an unnecessary film could not be suppressed completely on the other hand, the mechanism for removing films, such as an oxide film, from a wafer front face was established, and performing process control with high precision more was called for.

[0011] On the other hand, when the front face of a wafer is being worn with the metal, quality is greatly related to temperature -- about the oxide film adhering to the front face, the reaction on the front face of a wafer activates according to the temperature of the front face of the wafer being high, and a reaction and adhesion progress. Moreover, it was also called for that local temperature control said [cooling the wafer in equipment from maintenance of equipment or the workability of human being in the time of failure and] can be performed.

[0012] Moreover, with the conventional composition, when a big difference appears in each processing time of the plating processor 22, the annealing processor 23, and the washing processor 23, the latency time (processor-limited time) occurs. Then, production capacity went up by processing late down stream processing with two or more equipments, and the substrate processor which can lessen the latency time was also called for.

[0013] The purpose of this invention is offering the substrate art and equipment which can make small dispersion in the history of the substrate (wafer) processed.

[0014] Moreover, other purposes of this invention are offering the substrate art and equipment which can prevent adhesion of the unnecessary film on the front face of a substrate.

[0015] Moreover, other purposes of this invention are offering the substrate art and equipment

which can lessen the latency time of each processor.
[0016]
[Means for Solving the Problem] A substrate art according to claim 1 is characterized by preparing a plating processor, a washing processor, and an annealing processor for the surroundings of a transfer machine, conveying a substrate one by one to a plating processor, a washing processor, and an annealing processor by the transfer machine, and performing plating processing of a substrate, washing processing, and annealing processing continuously while it prepares the transfer machine which transfers a substrate.
[0017] In order according to this method to carry out full automatic conveyance of between each process process of plating processing, washing processing, and annealing processing for a substrate by the transfer machine and to carry out consecutive processing of the process of plating, washing, and annealing, a substrate can be conveyed in a short time and the latency time of each processor also decreases, and it is stabilized also in the time concerning a series of processes of plating processing, washing processing, and annealing processing, and becomes that it is possible in making dispersion in the history of a substrate small.
[0018] While a substrate art according to claim 2 makes two or more transfer machines which transfer a substrate adjoin and prepares them A plating processor, a washing processor, and an annealing processor are prepared for the surroundings of two or more transfer machines made to adjoin. It is characterized by for two or more transfer machines delivering a substrate between adjoining transfer machines, conveying a substrate one by one to a plating processor, a washing processor, and an annealing processor by two or more transfer machines, and performing plating processing of a substrate, washing processing, and annealing processing continuously.
[0019] according to this method, the same effect as a claim 1 is acquired, and also by preparing two or more transfer machines, it becomes possible to arrange many processors around two or more transfer machines, and it becomes possible to set up the throughput of each down stream , processing at arbitration
[0020] A substrate art according to claim 3 is characterized by preparing two or more at least one of a plating processor, a washing processor, and annealing processors, and performing plating processing of a substrate, washing processing, and annealing processing continuously in a substrate art according to claim 1 or 2.
[0021] The capacity over down stream processing which the prepared processor should perform by this method improves. For example, when a big difference is in the time of each down stream processing to one substrate, by preparing two or more these processors for a long time, the processing time can make capacity of the down stream processing equivalent to the capacity of other down stream processing, and can make the minimum the latency time by the processing-time difference of each processor.
[0022] A substrate art according to claim 4 is set to a substrate art according to claim 1, 2, or 3. an annealing processor The annealing chamber which carries out annealing processing of the substrate, and the process gas processor which controls the amount of introduction while introducing in an annealing chamber by making inert gas, such as nitrogen, into process gas, The annealing processor equipped with the evacuation mechanism which discharges the gas in an annealing chamber, and the atmospheric pressure vent mechanism in which the pressure in an annealing chamber is adjusted is prepared. It is characterized by performing annealing processing, controlling the atmosphere in an annealing chamber by the process gas processor, the evacuation mechanism, and the atmospheric pressure vent mechanism.
[0023] While performing pressure regulation in an annealing chamber by the atmospheric pressure vent mechanism, making inert gas, such as nitrogen, flow by the process gas processor, oxygen tension can be lowered, or the gas in an annealing chamber can be exhausted according to an evacuation mechanism, and the atmosphere in an annealing chamber can be controlled by this method. Adhesion of unnecessary films, such as an oxide film to the front face of a substrate, can be suppressed by as a result, for example, an inactive atmosphere, carrying out.
[0024] In a substrate art according to claim 4, a substrate art according to claim 5 is characterized by performing annealing processing, while an annealing processor adds hydrogen gas to the

process gas introduced in an annealing chamber from a process gas processor, prepares the annealing processor which established the hydrogen introduction mechanism which controls the addition and controls a hydrogen partial pressure by the hydrogen introduction mechanism.
[0025] Thus, in the process gas processor which established the hydrogen introduction mechanism, by the ability of hydrogen to be introduced into an annealing chamber, hydrogen reacts at oxygen and an elevated temperature, serves as water and can be eliminated. Therefore, by introducing hydrogen into an annealing chamber so much, the amount of indoor oxygen is purged and it decreases. Annealing processing of a substrate can be performed, lowering oxygen tension, and it is also that an evacuation mechanism and an atmospheric pressure vent mechanism can discharge dangerous process gas and dangerous moisture. A substrate can be processed efficiently, raising quality, adhesion of unnecessary films, such as an oxide film to the front face of a substrate, can be suppressed more, and the process which returns the front face of a substrate further can be realized.
[0026] In a substrate art according to claim 4 or 5, a substrate art according to claim 6 is characterized by performing annealing processing, while an annealing processor prepares the annealing processor which formed the plasma generating machine which generates plasma ion within an annealing chamber and generates plasma ion with a plasma generating machine.
[0027] Thus, by generating plasma ion, unnecessary films, such as an oxide film which adhered on the surface of the substrate, can be returned, and it can return to the state of the film of a basis.
[0028] A substrate art according to claim 7 is characterized by for an annealing processor preparing the annealing processor which attached in the gas entrance into one [at least] annealing chamber of a process gas processor and an atmospheric pressure vent mechanism the angle adjustment diffuser which can adjust the direction of the blowdown of gas, blowing off gas from an angle adjustment diffuser after annealing processing, and performing local temperature control in an annealing chamber in a substrate art according to claim 4, 5, or 6.
[0029] Thus, by having attached the angle adjustment diffuser, it is possible to send out gas locally into an annealing chamber, and the substrate can be cooled by blowing off from an angle adjustment diffuser and applying the gas of temperature lower than the inside of an annealing chamber to a substrate directly. Consequently, improvement in the workability of human being who suppresses adhesion of the oxide film by the skin temperature of a substrate being high, and deals with a substrate at the time of maintenance and failure of equipment can be aimed at.
[0030] A substrate processor according to claim 8 arranges a plating processor, a washing processor, and an annealing processor around the transfer machine which transfers a substrate, and is characterized by enabling conveyance of a substrate by the transfer machine at a plating processor, a washing processor, and an annealing processor.
[0031] According to this composition, full automatic conveyance of between each process process of plating processing, washing processing, and annealing processing can be carried out for a substrate by the transfer machine, and consecutive processing of the process of plating, washing, and annealing can be carried out. Consequently, a substrate can be conveyed in a short time, the latency time of each processor also decreases, the time concerning a series of processes of plating processing, washing processing, and annealing processing is also stabilized, and it becomes possible to make dispersion in the history of a substrate small.
[0032] A plating processor, a washing processor, and an annealing processor are arranged around two or more transfer machines, and a substrate processor according to claim 9 is characterized by having enabled delivery of a substrate between adjoining transfer machines, and enabling conveyance of a substrate by two or more transfer machines at a plating processor, a washing processor, and an annealing processor while two or more transfer machines which transfer a substrate are made to adjoin and it arranges them.
[0033] since according to this composition the same effect as a claim 8 is acquired and also two or more transfer machines are prepared, it becomes possible to arrange many processors around two or more transfer machines, and it becomes possible to set up the throughput of each down stream processing at arbitration
[0034] A substrate processor according to claim 10 is characterized by preparing two or more at

least one of a plating processor, a washing processor, and annealing processors in a substrate processor according to claim 8 or 9.
[0035] The capacity over down stream processing which the formed processor should perform by this composition improves. For example, when a big difference is in the time of each down stream processing to one substrate, by forming two or more these processors for a long time, the processing time can make capacity of the down stream processing equivalent to the capacity of other down stream processing, and can make the minimum the latency time by the processing-time difference of each processor.
[0036] A substrate processor according to claim 11 is characterized by equipping an annealing processor with the annealing chamber which carries out annealing processing of the substrate, the process gas processor which controls the amount of introduction while introducing in an annealing chamber by making inert gas, such as nitrogen, into process gas, the evacuation mechanism which discharges the gas in an annealing chamber, and the atmospheric pressure vent mechanism in which the pressure in an annealing chamber is adjusted in a substrate processor according to claim 8, 9, or 10.
[0037] While performing pressure regulation in an annealing chamber by the atmospheric pressure vent mechanism, making inert gas, such as nitrogen, flow by the process gas processor, oxygen tension can be lowered, or the gas in an annealing chamber can be exhausted according to an evacuation mechanism, and the atmosphere in an annealing chamber can be controlled by this composition. Adhesion of unnecessary films, such as an oxide film to the front face of a substrate, can be suppressed by as a result, for example, an inactive atmosphere, carrying out.
[0038] In a substrate processor according to claim 11, a substrate processor according to claim 12 is characterized by establishing the hydrogen introduction mechanism which controls the addition while an annealing processor adds hydrogen gas to the process gas introduced in an annealing chamber from a process gas processor.
[0039] Thus, in the process gas processor which established the hydrogen introduction mechanism, by the ability of hydrogen to be introduced into an annealing chamber, hydrogen reacts at oxygen and an elevated temperature, serves as water and can be eliminated. Moreover, annealing processing of a substrate can be performed, lowering oxygen tension, and while an evacuation mechanism and an atmospheric pressure vent mechanism become possible [also discharging dangerous process gas and dangerous moisture] and raise quality, a substrate can be processed efficiently, adhesion of unnecessary films, such as an oxide film to the front face of a substrate, can be suppressed more, and the process which returns the front face of a substrate further can be realized.
[0040] A substrate processor according to claim 13 is characterized by an annealing processor forming the plasma generating machine which generates plasma ion within an annealing chamber in a substrate processor according to claim 11 or 12.
[0041] Thus, by generating plasma ion, unnecessary films, such as an oxide film which adhered on the surface of the substrate, can be returned, and it can return to the state of the film of a basis.
[0042] A substrate processor according to claim 14 is characterized by an annealing processor attaching in the gas entrance into one [at least] annealing chamber of a process gas processor and an atmospheric pressure vent mechanism the angle adjustment diffuser which can adjust the direction of the blowdown of gas in a substrate processor according to claim 11, 12, or 13.
[0043] Thus, by having attached the angle adjustment diffuser, it is possible to send out gas locally into an annealing chamber, and the substrate can be cooled by blowing off from an angle adjustment diffuser and applying the gas of low temperature to a substrate directly from the inside of an annealing chamber. Consequently, improvement in the workability of human being who suppresses adhesion of the oxide film by the skin temperature of a substrate being high, and deals with a substrate at the time of maintenance and failure of equipment can be aimed at.
[0044]
[Embodiments of the Invention] It explains referring to a drawing hereafter about the substrate art and equipment of a gestalt of operation of this invention which are used in a metal wiring formation process.

[0045] (Gestalt : the claims 1, 3, 8, and 10 of the 1st operation relation) Drawing 1 is the plan showing the composition of the 1st of the substrate processor of the gestalt of operation of this invention. In drawing 1 , 1 is the plating room of the plating processor equipped with the mechanism in which surface treatment, such as copper coating, is performed. 2 is the washing room of the washing processor equipped with the mechanism which washes the metal contamination of those other than the portion originally plated by for example, plating processing. 3 is the annealing chamber of the annealing processor equipped with the heating mechanism which stabilizes the metal membrane on front faces of a wafer, such as metaled annealing, when a metal membrane is formed in a wafer front face by plating. 4 is a concentration room and has the structure where the plating room 1 and the washing room 2 which have been arranged around it, and an annealing chamber 3 are connectable.

[0046] 5 is the transfer machine prepared in the concentration room 4, for example, consists of a carrier robot, and can perform wafer conveyance between the plating room 1, the washing room 2, an annealing chamber 3, the injection cassette 7, and the drawing cassette 8. 6 is a cassette base for placing the injection cassette 7 and the drawing cassette 8. The wafer processed from now on is contained by the injection cassette 7, and a wafer [finishing / processing] is contained by the ejection cassette 8.

[0047] 20a, 20b, and 20c are gate valves, and have the structure where it can respond to interception and the pressure differential of gas. For example, gate-valve 20c which exists in the joining segment of the concentration room 4 and an annealing chamber 3 is explained. The inside of an annealing chamber 3 performs wafer processing by hot dangerous gas during annealing process processing. Then, environmental separation, such as jet of the dangerous gas by the pressure differential, is needed by the joining segment of the concentration room 4 and an annealing chamber 3, and environmental separation is performed by closing gate-valve 20c. Moreover, after the completion of processing will open gate-valve 20c, and will take out a wafer from the inside of an annealing chamber 3 by the transfer machine 5.

[0048] Thus, the substrate art realized by the substrate processor constituted is explained. For example, plating processing and a degree consider as washing processing, and a degree considers [the first processing] as annealing processing. Gate valves 20a, 20b, and 20c begin, and are closed.

[0049] First, one wafer is picked out from the injection cassette 7 by the transfer machine 5. At this time, gate-valve 20a between the plating room 1 and the concentration room 4 has been closed. And a wafer is conveyed by the transfer machine 5 in front of gate-valve 20a, and the inside of the plating room 1 opens gate-valve 20a after a process start preparation completion, and it transfers into the plating room 1.

[0050] Next, after completing plating processing, gate-valve 20a is opened, a wafer is taken out from the plating room 1 by the transfer machine 5, and conveyance is performed before gate-valve 20b of the washing room 2. The inside of the washing room 2 opens gate-valve 20b after a process start preparation completion, and transfers into the washing room 2.

[0051] Next, after completing washing processing, gate-valve 20b is opened, a wafer is taken out from the washing room 2 by the transfer machine 5, and conveyance is performed before gate-valve 20c of an annealing chamber 3. The inside of an annealing chamber 3 opens gate-valve 20c after a process start preparation completion, and transfers into an annealing chamber 3.

[0052] Next, after completing annealing processing, gate-valve 20c is opened, a wafer is taken out from an annealing chamber 3 by the transfer machine 5, and it conveys to the ejection cassette 8.

[0053] Although operation of a substrate processor explained above that conveyance about one wafer and processing understood well, conveyance and processing of two or more wafers are explained referring to drawing 2 further in fact, since two or more wafers are conveyed and processed one by one. Drawing 2 is drawing showing the conveyance state of a wafer in the substrate processor of the gestalt of this operation. Here, plating processing and a degree consider as washing processing, and a degree considers [the first processing] as annealing processing.

[0054] First, two or more wafers are contained by the injection cassette 7. It considers as Wafer A, Wafer B, Wafer C, Wafer D, Wafer E, and ..... at the turn processed (state of drawing 2 (1)).

[0055] The first wafer A is picked out from the injection cassette 7 by the transfer machine 5. And Wafer A is conveyed by the transfer machine 5, and it transfers into the plating room 1 (state of drawing 2 (2)). Here, the wafer processing time in the plating room 1 is made into 3 minutes.
[0056] After completing the plating processing for 3 minutes, Wafer A is conveyed from the plating room 1 to the washing room 2 by the transfer machine 5. Also let the next washing processing be the wafer processing time for 3 minutes. A transfer machine 5 picks out Wafer B from the injection cassette 7, and transfers it into the plating room 1 in the meantime (state of drawing 2 (3)).
[0057] A transfer machine 5 conveys Wafer A from the washing room 2 to an annealing chamber 3, after completing the washing processing for 3 minutes, and after completing the plating processing for 3 minutes, it conveys the wafer B from the plating room 1 to the washing room 2. And Wafer C is picked out from the injection cassette 7, and it transfers into the plating room 1 (state of drawing 2 (4)).
[0058] In the case of 3 minutes, the process in an annealing chamber 3 is also taken out from an annealing chamber 3 after the completion of processing of annealing processing, washing processing, and each plating processing, and passes cassette 8, and Wafer C is conveyed [Wafer A] for Wafer B by the transfer machine 5 from the washing room 2 from the plating room 1 to the washing room 2 to an annealing chamber 3. Furthermore, Wafer D is conveyed by the transfer machine 5 from the injection cassette 7 at the plating room 1 (state of drawing 2 (5)).
[0059] As mentioned above, according to the gestalt of this operation, by arranging a plating processor (plating room 1), a washing processor (washing room 2), and an annealing processor (annealing chamber 3), full automatic conveyance can be carried out [between / each process process of plating processing, washing processing and annealing processing] in a wafer by the transfer machine 5, and consecutive processing can be stabilized and carried out in plating processing, washing processing, and annealing processing to the surroundings of the concentration room 4 in which the transfer machine 5 was installed Consequently, a wafer can be conveyed in a short time, the latency time of each processor also decreases, the time concerning a series of processes of plating processing, washing processing, and annealing processing is also stabilized, and it becomes possible to make dispersion in the history of a wafer small. In the above-mentioned example, as any wafer processing time of the plating room 1, the washing room 2, and an annealing chamber 3 was made into 3 minutes, when carrying out the same baton processing, a wafer can be conveyed most efficiently, and the time concerning a series of processes of plating processing, washing processing, and annealing processing does not have waiting, either, and becomes possible [making dispersion in a wafer history small]. On the other hand, even when the processing time of each process is different, according to the longest time, it becomes possible by performing wafer conveyance to make dispersion in a history small.
[0060] In addition, with the gestalt of this operation, although flat-surface composition of the concentration room 4 was made into the square, it does not restrict to a square. Moreover, with the gestalt of this operation, although it has arranged each a plating processor, a washing processor, and one annealing processor around [each] the concentration room 4, you may arrange two or more at least one processors (it relates to claims 3 and 10). For example, when a big difference is in the time of each down stream processing to one substrate, by preparing two or more sets of this processor for a long time, the processing time can make capacity of the down stream processing equivalent to the capacity of other down stream processing, and can make the minimum the latency time by the processing-time difference of each processor. Moreover, to the processor formed two or more sets, it throws a wafer into two or more sets of the processors, and in failure or repair, some processors can convey in the processing room of the processor which can be processed, and it not only heightens the capacity of the down stream processing, but they can perform the down stream processing by the transfer machine 5 two or more sets of inside.
[0061] (Gestalt : the claims 4 and 11 of the 2nd operation relation) 9 is a process gas processor, it has the function which controls the process gas flow rate while it introduces inert gas, such as nitrogen, into an annealing chamber 3 as process gas, for example, drawing 3 is drawing showing the composition of the 2nd of the annealing processor of the substrate processor of the gestalt of

operation of this invention, and it is equipped with a mass-flow controller (not shown), an air drive bulb (not shown), etc. 10 is an evacuation mechanism, has the function which exhausts the gas in an annealing chamber 3, for example, is equipped with a vacuum pump (not shown), a bulb (not shown), etc. 11 is an atmospheric pressure vent mechanism, by measuring the pressure in an annealing chamber 3, discharging the gas in an annealing chamber 3, or introducing gas into an annealing chamber 3, has the function to adjust the pressure in an annealing chamber 3 to predetermined atmospheric pressure, for example, is equipped with a gas introduction bulb (not shown), a pressure sensor (not shown), a relief valve (not shown), etc.

[0062] That is, the feature of the gestalt of this operation is that the annealing processor equips the interior with the process gas processor 9, the evacuation mechanism 10, and the atmospheric pressure vent mechanism 11, and other composition is the same as that of the gestalt of the 1st operation.

[0063] Thus, the substrate art realized by the substrate processor constituted is explained, referring to drawing 1 and drawing 3 .

[0064] For example, gate-valve 20b is opened after completing washing processing, a wafer is taken out from the washing room 2 by the transfer machine 5, and it conveys before gate-valve 20c of an annealing chamber 3. If the inside of an annealing chamber 3 will be in an atmospheric pressure state or a pressure state a little higher than atmospheric pressure according to the state of a process start preparation completion, for example, nitrogen, gate-valve 20c will be opened and a wafer will be transferred into an annealing chamber 3. In addition, on the process condition, when making the inside of an annealing chamber 3 into a pressure a little higher than atmospheric pressure, in case gate-valve 20c is opened and a wafer is transferred into an annealing chamber 3, it is for stopping the contamination of oxygen to the minimum, and the minute amount purge of nitrogen is performed in the time of wanting to always lower oxygen tension.

[0065] Next, gate-valve 20c is closed and the temperature up for annealing processing and process gas introduction are started. For example, the inside of an annealing chamber 3 is heated by the resistance-wire heating machine (not shown), and nitrogen gas is introduced by the process gas processor 9. Under the present circumstances, when there is too much gas-stream close from the process gas processor 9 or the pressure in an annealing chamber 3 exceeds a predetermined pressure by the elevated-temperature-ized gas, the pressure of an annealing chamber 3 is adjusted by the atmospheric pressure vent mechanism 11.

[0066] In order to take out a wafer from the inside of an annealing chamber 3 safely, the nitrogen gas of ordinary temperature is introduced in large quantities by the atmospheric pressure vent mechanism 11 from a gas introduction bulb (not shown), it mixes with the hot process gas in an annealing chamber 3 according to the evacuation mechanism 10, and after annealing process completion is discharged. And gate-valve 20c can be opened by returning, for example to an atmospheric pressure state. Next, gate-valve 20c is opened, a transfer machine 5 is used to the ejection cassette 8, and a wafer is conveyed.

[0067] According to the gestalt of this operation, the atmosphere of an annealing chamber 3 can carry out partial pressure control freely as mentioned above according to the process gas processor 9, the evacuation mechanism 10, and the atmospheric pressure vent mechanism 11. Therefore, it has these mechanisms, and by controlling the atmosphere of an annealing chamber 3, the process which needs the wafer surface treatment in an atmosphere inactive, for example can be performed, and adhesion of the unnecessary film on the front face of a wafer, for example, adhesion of an oxide film, can be suppressed.

[0068] (Gestalt : the claims 5 and 12 of the 3rd operation correspondence) Drawing 4 is drawing showing the composition of the 3rd of the annealing processor of the substrate processor of the gestalt of operation of this invention, and gives the same sign to the same portion as drawing 3 . In drawing 4 , 12 is a hydrogen introduction mechanism. This hydrogen introduction mechanism 12 has the function to control the flow rate while introducing hydrogen gas, for example, it is equipped with a mass-flow controller (not shown) or an air valve (not shown).

[0069] That is, with the gestalt of this operation, the hydrogen introduction mechanism 12 is formed in the process gas processor 9 in the gestalt of the 2nd operation.

[0070] Thus, the substrate art by which it is characterized [of the gestalt of this operation realized by the substrate processor constituted] is explained. The hydrogen introduction mechanism 12 is connected with the process gas processor 9, and can add hydrogen gas to process gas. Hydrogen reacts at oxygen and an elevated temperature, by introducing hydrogen into an annealing chamber 3, serves as water and can be eliminated, and annealing processing of a wafer can be performed, lowering oxygen tension. Furthermore, the process which returns a wafer front face is realizable. The reaction of hydrogen and oxygen is expressed with the following formula.
[0071] 2H++O2-=H2 O -- a mixing ratio with the process gas introduced by adjustment of the mass-flow controller (not shown) of the hydrogen introduction mechanism 12 from the process gas processor 9 in that case -- the reduction reacting weight on the front face of a wafer changes by changing a rate An outline is shown in drawing 5 about the relation between the percentage of hydrogen gas, and the amount of etching on the front face of a wafer. Although a reduction reaction can be promoted by increasing the amount of hydrogenation and enlarging the percentage, it is accompanied by risk, such as explosion. Then, it is necessary to maintain safety by using the evacuation mechanism 10 together.
[0072] By performing process gas processing, controlling a hydrogen partial pressure, while forming the hydrogen introduction mechanism 12 in the process gas processor 9 and adding hydrogen gas to process gas according to the gestalt of this operation as mentioned above, oxygen reacts with hydrogen, serves as water and can be eliminated. Moreover, while it also becomes possible to be able to perform annealing processing of a wafer, lowering oxygen tension, and to discharge dangerous process gas and dangerous moisture according to the evacuation mechanism 10 and the atmospheric pressure vent mechanism 11 and it raises quality, a wafer can be processed efficiently, adhesion of unnecessary films, such as an oxide film to the front face of a wafer, can be suppressed more, and the process which returns the front face of a wafer further can be realized.
[0073] (Gestalt [of the 4th operation]; the claims 6 and 13 relation) Drawing 6 is drawing showing the composition of the 4th of the annealing processor of the substrate processor of the gestalt of operation of this invention, and gives the same sign to the same portion as drawing 4 . In drawing 6 , 13 is the plasma generating machine equipped with two electrodes 14 and 15 which were made to counter in parallel and have been arranged within an annealing chamber 3, for example, generates a 13.56MHz alternating current.
[0074] In addition to the 3rd composition of the gestalt of operation, the gestalt of this operation forms the plasma generating machine 13 which generates plasma in an annealing chamber 3 in an annealing processor. An alternating current is impressed to one electrode 14 of the plasma generating machine 13 arranged in an annealing chamber 3, the electrode 15 of another side is made into grounding potential, and a wafer 21 is laid on this electrode 15.
[0075] Thus, the substrate art by which it is characterized [of the gestalt of this operation realized by the substrate processor constituted] is explained.
[0076] A wafer 21 is laid on the electrode 15 in an annealing chamber 3. Next, the process gas processor 9 is minded according to the hydrogen introduction mechanism 12, and it is minute amount style ** about hydrogen gas in an annealing chamber 3. And the pressure in an annealing chamber 3 is lowered according to the evacuation mechanism 10, and it adjusts by the atmospheric pressure vent mechanism 11 so that it may become the predetermined pressure of 1x10-1torr within the limits from 1x10-3torr. And the alternating current of 13.56MHz and 100V is impressed to an electrode 14 with the plasma generating machine 13. Then, hydrogen is ionized and wafer 21 front face on an electrode 15 is returned. For example, the reduction reaction of oxidized copper is shown by the following formula in wafer 21 front face by which copper coating was carried out.
[0077]
Plasma electric discharge H2+2 e->H (gas)+H (gas) wafer front face CuO+2H (gas) ->Cu+H2 O
Getting it blocked, the copper oxide of wafer 21 front face returns to the copper in the state even if returned.
[0078] As mentioned above, according to the gestalt of this operation, by generating plasma ion with the plasma generating machine 13, unnecessary films, such as an oxide film adhering to the wafer front face, can be returned, and it can return to the state of the film of a basis.

[0079] In addition, about the generating method of plasma, it does not restrict to the composition of the gestalt of this operation. moreover, the thing which restricts the gas made into plasma with the plasma generating machine 13 to hydrogen -- it is not -- CF4 etc. -- it can also use In this case, what is necessary is just to establish the gas introduction mechanism which can control introduction and its amount of introduction for those gas instead of the hydrogen introduction mechanism 12.

[0080] (Form : the claims 7 and 14 of the 5th operation relation) Drawing 7 is drawing showing the annealing processor of the substrate processor of the form of operation of the 5th of this invention, and the composition of a transfer machine, and gives the same sign to the same portion as drawing 3 . In drawing 7 , 16a is an angle adjustment diffuser for process gas processor 9. 16b is an angle adjustment diffuser for atmospheric pressure vent mechanism 11. 17 is a wafer cooling diffuser for transfer-machine 5 for blowing off the gas of ordinary temperature into the portion into which a wafer 21 is loaded by the transfer machine 5, and cooling a wafer 21. 18a shows the atmosphere of a portion where the wafer 21 in an annealing chamber 3 is laid, and calls it wafer right above atmosphere. 18b -- gate-valve 20c -- an inside atmosphere is shown immediately and it is called the horizontal atmosphere in a gate valve 18c shows the atmosphere of a portion where the wafer 21 of a transfer machine 5 is loaded, and calls it transfer on-board atmosphere.

[0081] The form of this operation has formed the angle adjustment diffusers 16a and 16b which can adjust the direction of the blowdown of gas to the gas diffuser to the annealing chamber 3 of the process gas processor 9 and the atmospheric pressure vent mechanism 11, respectively in the annealing processor. Furthermore, with the form of this operation, the wafer cooling diffuser 17 is formed in the transfer machine 5.

[0082] Thus, the substrate art by which it is characterized [of the form of this operation realized by the substrate processor constituted] is explained.

[0083] Angle adjustment diffuser 16a for process gas processor 9 is located in right above [of the wafer 21 currently laid in the annealing chamber 3]. The ambient temperature in an annealing chamber 3 amounts to 300 degrees or more after annealing processing. Then, the nitrogen gas of ordinary temperature is blown off from angle adjustment diffuser 16a for process gas processor 9. This nitrogen gas cools wafer right above atmosphere 18a. Therefore, the wafer 21 located in the interior is cooled gradually.

[0084] Moreover, when a wafer 21 is taken out by the transfer machine 5 from an annealing chamber 3, the inside of an annealing chamber 3 is first returned to atmospheric pressure according to the atmospheric pressure vent mechanism 11. At this time, the nitrogen gas of ordinary temperature blows off from angle adjustment diffuser 16b for atmospheric pressure vent mechanism 11, and horizontal atmosphere in gate valve 18b is cooled. In case gate-valve 20c opens, a transfer machine 5 holds a wafer 21 and it takes out out of an annealing chamber 3, cooling progresses further by crossing horizontal atmosphere in gate valve 18b.

[0085] Moreover, the nitrogen gas of ordinary temperature blows off from the angle adjustment diffuser 17 attached in the transfer machine 5, transfer on-board atmosphere 18c is cooled, and a wafer 21 can be completely cooled at 100 or less degrees.

[0086] As mentioned above, according to the form of this operation, by having attached the angle adjustment diffusers 16a and 16b, it is possible to send out gas locally and a wafer 21 can be cooled by applying the gas of temperature lower than the inside of an annealing chamber 3 to a wafer 21 directly from the angle adjustment diffusers 16a and 16b. Consequently, improvement in the workability of human being who suppresses adhesion of the oxide film by the skin temperature of a wafer 21 being high, and deals with a wafer 21 at the time of maintenance and failure of equipment can be aimed at.

[0087] In addition, angle adjustment diffuser 16a for process gas processor 9 is turned to wafer right above atmosphere 18a, and it fixes, and angle adjustment diffuser 16b for atmospheric pressure vent mechanism 11 may be turned to horizontal atmosphere in gate valve 18b, and you may fix, and may make it make the direction of each angle adjustment diffuser 16a and 16b follow according to the movement of a wafer 21. When the direction of the angle adjustment diffusers 16a and 16b is being fixed, it is desirable to cover all the path top that a wafer 21 moves within an

annealing chamber 3 by the gas which blows off from two angle adjustment diffusers 16a and 16b.

[0088] In addition, although condition **** of gas discharge quantity or time was performed with the form of this operation so that the temperature of the wafer 21 which was 300 degrees or more might turn into 100 or less degrees by three kinds of diffusers 16a, 16b, and 17 by exposing to the nitrogen gas of ordinary temperature 30 seconds or more The conveyance time (time until gate-valve 20c opens from from and it is carried out by the transfer machine 5 immediately after annealing a wafer 21) of a transfer machine 5, and the direction of the blowdown of the gas of the angle adjustment diffusers 16a and 16b can be set up arbitrarily.
[0089] Moreover, although the angle adjustment diffusers 16a and 16b and the wafer cooling diffuser 17 are formed with the form of this operation in order to heighten refrigeration capacity more, if either is prepared among the angle adjustment diffusers 16a and 16b, it is possible to acquire the effect of the form of this operation.
[0090] In addition, also in the form of this operation, a hydrogen introduction mechanism 12 like the form of the 3rd operation may be formed in an annealing processor, and a plasma generating machine 13 like the form of the 4th operation may be formed.
[0091] (Form : the claims 2, 3, 9, and 10 of the 6th operation relation) Drawing 8 is the plan showing the composition of the 6th of the substrate processor of the form of operation of this invention. In drawing 8 , 1a and 1b are the plating rooms of the 1st and 2nd plating processor, 2 is the washing room of a washing processor, and 3a and 3b are the annealing chambers of the 1st and 2nd annealing processor. 4a and 4b are the substrate processors with which the flat-surface configuration carried out the shape of a polygon of four or more square shapes, and it has the structure where the plating rooms 1a and 1b, the washing room 2, and annealing chambers 3a and 3b are connectable. Moreover, connection can do concentration room 4a and concentration room 4b like annealing-chamber 3a etc. 5a and 5b are the transfer machine 5 of drawing 1 , and the transfer machine which conveys a wafer similarly, and also perform delivery of a wafer between transfer-machine 5a and transfer-machine 5b here. 21a, 21b, and 21c are process chambers, can be set as the processing room of arbitrary process processors, such as post-washing, and have structure connectable with the concentration rooms 4a and 4b like annealing-chamber 3a etc.
[0092] With the form of this operation, concentration room 4a and concentration room 4b which formed transfer machines 5a and 5b, respectively were made to adjoin, it has arranged, and two plating rooms 1a and 1b, one washing room 2, two annealing chambers 3a and 3b, and three process chambers 21a, 21b, and 21c are arranged around two concentration rooms 4a and 4b.
[0093] Thus, the substrate art realized by the substrate processor constituted is explained. Here, in order to give explanation easy, the movement of one wafer is explained later on. Moreover, the first processing considers as plating processing by washing processing and process processings that a degree is [annealing processing and a degree] arbitrary, and a degree considers for example, as post-washing processing. Moreover, suppose that process chamber 21a was set as the processing room of a post-washing processor among the process chambers 21a, 21b, and 21c here.
[0094] First, one wafer is picked out from the injection cassette 7 by transfer-machine 5a, and it is conveyed by transfer-machine 5a to plating room 1a or plating room 1b. For example, plating room 1a is already working, and if plating room 1b is a waiting state, it will supply to plating room 1b of a waiting state. Then, it is conveyed at the washing room 2 and goes to annealing processing after washing processing. At this time, conveyance is possible to both annealing-chamber 3a or annealing-chamber 3b. For example, during operation, when annealing-chamber 3b conveys to annealing-chamber 3b in the waiting state, it passes a wafer to transfer-machine 5b from transfer-machine 5a, and annealing-chamber 3a is conveyed. That is, a wafer will move from concentration room 4a to concentration room 4b. And a wafer is thrown into annealing-chamber 3b by transfer-machine 5b. A wafer is taken out from annealing-chamber 3b by transfer-machine 5b after annealing processing, and a wafer injection is performed to process chamber 21a set as the post-washing room. After post-washing processing and after taking out a wafer from process chamber 21a by transfer-machine 5b, a wafer is passed to transfer-machine 5a from transfer-machine 5b, a wafer is taken out by transfer-machine 5a, and it contains to a cassette 8.

[0095] since according to the form of this operation the same effect as the form of the 1st operation is acquired and also two concentration rooms 4a and 4b which were equipped with transfer machines 5a and 5b, and carried out contiguity arrangement are formed, it becomes possible to arrange many processors around two concentration rooms 4a and 4b, and it becomes possible to set up the throughput of each down stream processing at arbitration Moreover, when a big difference is in the time of each down stream processing to one substrate, by preparing two or more sets of this processor for a long time, the processing time can make capacity of the down stream processing equivalent to the capacity of other down stream processing, and can make the minimum the latency time by the processing-time difference of each processor. Moreover, to the processor (the form of this operation a plating processor, an annealing processor) formed two or more sets, it throws a wafer into two or more sets of the processors, and in failure or repair, some processors can convey in the processing room of the processor which can be processed, and it not only heightens the capacity of the down stream processing, but they can perform the down stream processing by transfer machines 5a and 5b two or more sets of inside.

[0096] In addition, although two concentration rooms 4a and 4b were formed with the form of this operation, it is also possible to connect further many concentration rooms. Moreover, although it is arbitrary also about the number of each processor arranged around those concentration rooms, as for at least one set, each of a plating processor, a washing processor, and an annealing processor shall be arranged.

[0097] Moreover, with the form of this operation, although the flat-surface configuration of the concentration rooms 4a and 4b was made into eight square shapes, it does not restrict to eight square shapes.

[0098] In addition, about each annealing processor which has annealing chambers 3a and 3b, it cannot be overemphasized that it is good also as composition explained with the form of the 2nd, the 3rd, the 4th, or the 5th operation, and is good also as composition which formed the wafer cooling diffuser 17 explained with the form of the 5th operation also about transfer machines 5a and 5b.

[0099]

[Effect of the Invention] As mentioned above, according to this invention, by having arranged the plating processor, the washing processor, and the annealing processor, and having enabled conveyance of a substrate by the transfer machine at the plating processor, the washing processor, and the annealing processor, full automatic conveyance of between each process process of plating processing, washing processing, and annealing processing can be carried out for a substrate by the transfer machine, and consecutive processing of the process of plating, washing, and annealing can be carried out to the surroundings of the transfer machine which transfers a substrate. Consequently, a substrate can be conveyed in a short time, the latency time of each processor also decreases, the time concerning a series of processes of plating processing, washing processing, and annealing processing is also stabilized, and it becomes possible to make dispersion in the history of a substrate small.

[0100] While making two or more transfer machines adjoin and arranging them, moreover, around two or more transfer machines Arrange a plating processor, a washing processor, and an annealing processor, and delivery of a substrate is enabled between adjoining transfer machines. By having enabled conveyance of a substrate by two or more transfer machines at the plating processor, the washing processor, and the annealing processor, it becomes possible to arrange many processors around two or more transfer machines, and it becomes possible to set up the throughput of each down stream processing arbitrarily.

[0101] Moreover, the capacity over down stream processing which the formed processor should perform improves by having prepared two or more at least one of a plating processor, a washing processor, and annealing processors. For example, when a big difference is in the time of each down stream processing to one substrate, by forming two or more these processors for a long time, the processing time can make capacity of the down stream processing equivalent to the capacity of other down stream processing, and can make the minimum the latency time by the processing-time difference of each processor.

[0102] Moreover, the annealing chamber which carries out annealing processing of the substrate at an annealing processor, The process gas processor which controls the amount of introduction while introducing in an annealing chamber by making inert gas, such as nitrogen, into process gas, By having had the evacuation mechanism which discharges the gas in an annealing chamber, and the atmospheric pressure vent mechanism in which the pressure in an annealing chamber was adjusted While performing pressure regulation in an annealing chamber by the atmospheric pressure vent mechanism, making inert gas flow by the process gas processor, oxygen tension can be lowered, or the gas in an annealing chamber can be exhausted according to an evacuation mechanism, and the atmosphere in an annealing chamber can be controlled. Adhesion of unnecessary films, such as an oxide film to the front face of a substrate, can be suppressed by as a result, for example, an inactive atmosphere, carrying out.

[0103] Furthermore, by the ability of hydrogen to be introduced into an annealing chamber by having established the hydrogen introduction mechanism which controls the addition, while adding hydrogen gas to the process gas introduced into an annealing processor in an annealing chamber from a process gas processor, hydrogen reacts at oxygen and an elevated temperature, serves as water and can be eliminated. Moreover, annealing processing of a substrate can be performed, lowering oxygen tension, and while an evacuation mechanism and an atmospheric pressure vent mechanism become possible [also discharging dangerous process gas and dangerous moisture] and raise quality, a substrate can be processed efficiently, adhesion of unnecessary films, such as an oxide film to the front face of a substrate, can be suppressed more, and the process which returns the front face of a substrate further can be realized.

[0104] Moreover, unnecessary films, such as an oxide film which adhered to the annealing processor on the surface of the substrate by forming the plasma generating machine which generates plasma ion within an annealing chamber, and generating plasma ion, can be returned, and it can return to the state of the film of a basis.

[0105] Moreover, it is possible to send out gas to an annealing processor locally into an annealing chamber by having attached in the gas entrance into one [at least] annealing chamber of a process gas processor and an atmospheric pressure vent mechanism the angle adjustment diffuser which can adjust the direction of the blowdown of gas, and the substrate can be cooled by blowing off from an angle adjustment diffuser and applying the gas of temperature lower than the inside of an annealing chamber directly at a substrate. Consequently, improvement in the workability of human being who suppresses adhesion of the oxide film by the skin temperature of a substrate being high, and deals with a substrate at the time of maintenance and failure of equipment can be aimed at.

[Translation done.]

TICES *

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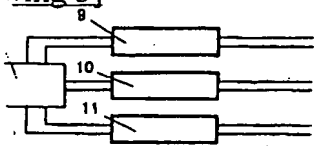
sely.
* shows the word which can not be translated.
he drawings, any words are not translated.

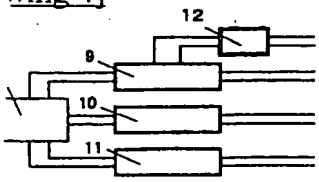
WINGS

wing 3]



9 プロセスガス処理機構
10 真空排気機構
11 気圧ベント機構

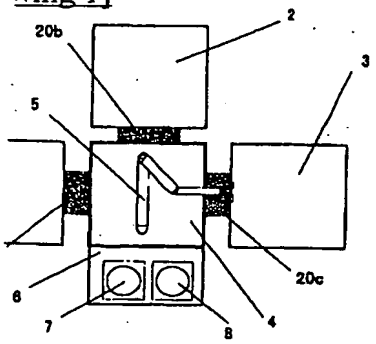
wing 4]



12 水素導入機構

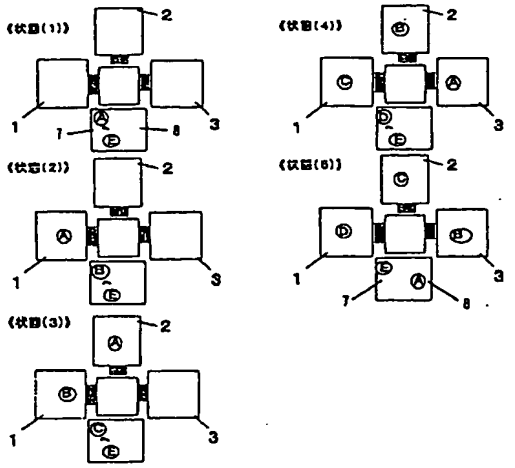
wing 9]

wing 1]

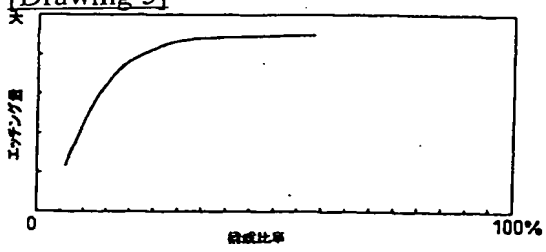


1 メッキ室
2 洗浄室
3 アニール室
4 集積室
5 移載機
6 カセット台
7 投入カセット
8 取り出しカセット
20a ゲートバルブ
20b ゲートバルブ
20c ゲートバルブ

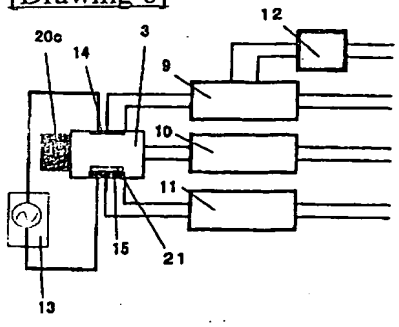
wing 2]



[Drawing 5]

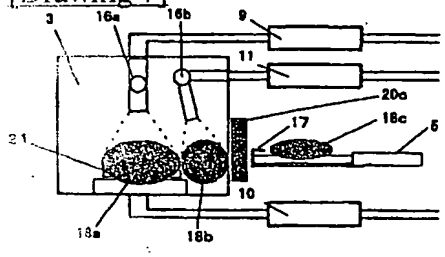


[Drawing 6]



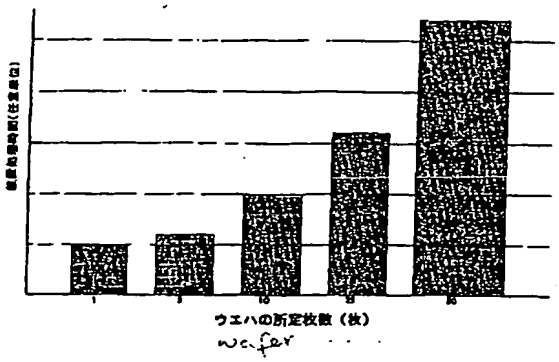
13 プラズマ発生器
21 ウエハ

[Drawing 7]

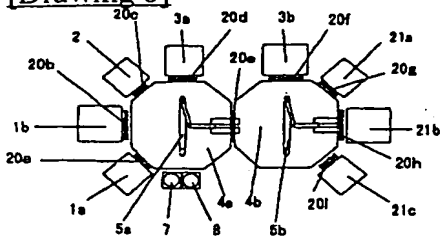


3 アニール室
5 移載機
9 プロセスガス処理機構
10 真空排気機構
11 処圧ベント機構
16a 角度固定吹き出し口
16b 角度調整吹き出し口
17 ウエハ冷却吹き出し口
18a ウエハ直上雰囲気
18b ゲートバルブ内側雰囲気
18c 移載機上雰囲気
21 ウエハ

[Drawing 10]

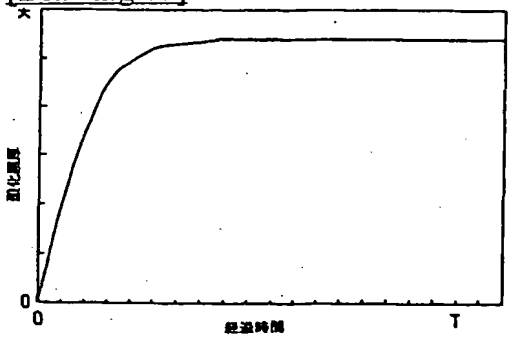


[Drawing 8]

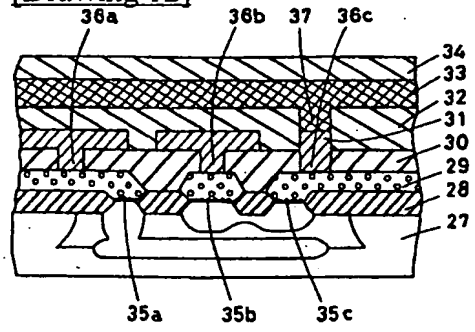


1a，1b　メッキ室
2　洗浄室
3a，3b　アニール室
4a，4b　装着室
5a，5b　移載機
7　投入カセット
8　取り出しカセット
20a～20i　ゲートバルブ
21a～21c　プロセスチャンバ

[Drawing 11]



[Drawing 12]



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